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Biological Data on Arctic Charr from the Salmon River, Baffin Island, Northwest Territories, 1979-1989

C.J. Read and M.M. Roberge

Central and Arctic Region
Department of Fisheries and Oceans
Winnipeg, Manitoba R3T 2N6

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BIOLOGICAL DATA ON ARCTIC CHARR FROM THE SALMON RIVER, BAFFIN ISLAND, NORTHWEST TERRITORIES, 1979-1989

by

C.J. Read and M.M. Roberge[1]

Central and Arctic Region

Department of Fisheries and Oceans

Winnipeg, Manitoba R3T 2N6

This is the 54th Data Report

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[1] Department of Fisheries and Oceans, Newfoundland Region
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ABSTRACT

Read, C.J., and M.M. Roberge. 1991. Biological data on Arctic Charr from the Salmon River, Baffin Island, Northwest Territories, 1979-1989. Can. Data Rep. Fish. Aquat. Sci. 828: iv + 19 p.

Salmon River was the site of the first study in a multi-year program started in 1986 to assess the Arctic charr stocks in the Pond Inlet area. Gill nets of various sizes were set in five different locations along the Salmon River system. The subsistence fishery was also sampled. In 1987 a tagging program was conducted. This report also includes data from the 1979 subsistence fishery as well as the results of experimental gill netting done in 1980. Harvest and biological data are presented. Harvest data includes historical records of Arctic charr harvested from the Salmon River as well as present day harvest estimates made by the Renewable Resource Officer, Pond Inlet. Biological data of the fish sampled includes length, weight, age and maturity characteristics.

Key words: Salvelinus alpinus L.; harvest; subsistence; anadromous; experimental gillnetting; migration/distribution.

RÉSUMÉ

Read, C.J., and M.M. Roberge. 1991. Biological data on Arctic Charr from the Salmon River, Baffin Island, Northwest Territories, 1979-1989. Can. Data Rep. Fish. Aquat. Sci. 828: iv + 19 p.

La rivière Salmon a été le premier site étudié dans le cadre d'un programme de plusieurs années commencé en 1986, et qui vise à évaluer les stocks d'ombles chevaliers dans la région de Pond Inlet. Des filets maillants de diverses tailles ont été installés à cinq endroits différents le long du réseau de la rivière Salmon. L'échantillonnage a aussi porté sur la pêche de subsistance. En 1987, un programme de marquage a été réalisé. Le présent rapport contient aussi des données sur la pêche de subsistance depuis 1979 ainsi que les résultats de la pêche expérimentale au filet maillant faite en 1980. On presente des données sur les prises ainsi que des données biologiques. Les données sur les prises comprennent les relevés historiques des prises d'omble chevalier dans la rivière Salmon ainsi que les évaluations des prises actuelles faites par l'agent des ressources renouvelables à Pond Inlet. Les données biologiques sur les poissons échantillonnés comprennent la longueur, le poids, l'âge et les caractéristiques de maturité.

Mots-clés: Salvelinus alpinus L.; données sur les prises; subsistance; espèce anadrome; pêche expérimentale; filets maillants; migration; distribution.

INTRODUCTION

Arctic charr, Salvelinus alpinus L., has a circumpolar distribution with the anadromous form found in coastal streams throughout its range (Scott and Crossman 1973). Anadromous Arctic charr are found in many of the lakes and rivers along the north coast of Baffin Island, in particular in the Pond Inlet Area (Fig. 1). Many of these charr stocks, including the Salmon River are currently being exploited by subsistence, commercial and/or sport fisheries.

Arctic charr has traditionally been an important food source to the Inuit of the area (Brody 1976). During the summer months prior to 1959 sapituts (stone fish weirs) were used to catch most of the fish (Brody 1976). After 1959 summer fishing was conducted primarily with gill nets set at river mouths and along the coast (Bisset 1967; Brody 1976). In the fall jigging lines and leisters were used to catch charr through iceholes and in the winter gill nets were set under the ice in the lakes.

In the early 1970's the quality of the Salmon River fishery declined noticeably. In response to this, the Pond Inlet hamlet encouraged conservation of the charr stock by reducing the fishing pressure.

In 1986, in response to general concerns that overfishing had reduced the charr stocks in the Pond Inlet area, the Department of Fisheries and Oceans (DFO) initiated a multi-year program to assess the status of Arctic charr in the area. The Salmon River was the first stock to be assessed. The study was initiated by gillnetting at a number of locations throughout the watershed (Fig. 1) and by sampling the subsistence fishery at the mouth of the river. In 1987 charr were gillnetted and tagged at two different locations on the river. Prior to this, a biological sample had been taken in 1979 (subsistence fishery) and in 1980 (experimental gillnetting) by DFO staff. This report presents these data.

STUDY AREA

The Salmon River (72°40'N, 78°04'W) is located approximately 2.5 km southwest of the community of Pond Inlet on Baffin Island, Northwest Territories (Fig. 1). Both branches of the Salmon River, each approximately 60 km in length, are glacial fed and drain into a common lake that then flows into Eclipse Sound. The largest lake on the watershed, Utuk Lake, forms part of the southwest branch of the river. Utuk Lake is about 12 km from the mouth of the river and has a surface area of approximately 1 250 ha. Utuk Lake was named after a part of the female anatomy that Inuit perceive as describing the deep and dark qualities of the lake.

THE FISHERY

Because of its close proximity to the community of Pond Inlet, Salmon River has historically been heavily fished in comparison to outlying areas (Bissett 1967). Traditionally, gill nets set at the mouth have been used during the early part of July when the anadramous run of Arctic charr are going to sea and again in mid-August when the upstream migration is taking place. In 1966-67 the community of Pond Inlet erected a fishing cabin at the north end of Utuk Lake to assist fishermen in netting Arctic charr through the ice.

There is no historical record of subsistence harvest by local Inuit but in 1904 (Low 1906), a scientific expedition reported harvesting 2200 kg of charr from Salmon River (Table 1). Another scientific expedition in 1910 reported a catch of 490 fish to feed the crew (Bernier 1912). Although there is no record of specific catches according to historical files kept by the Renewable Resource Officer, Pond Inlet, there was an abundance of fish in Salmon River prior to the 1970's (R. Popko and B. Dean, Department of Renewable Resources, Government of Northwest Territories, Pond Inlet, NT, personal communication). However, a rapid decline in the fishery occurred in the early 1970's and in response to this, the Pond Inlet hamlet encouraged conservation of the charr stock by reduced fishing. This resulted in a self-induced moratorium. The present Renewable Resource Officer of Pond Inlet (B. Dean) observed an increase in the amount of fishing in 1988. In 1989 fishing pressure increased even more with reports of catches exceptional in size and quanitity compared to those of the previous 15 to 20 years.

METHODS AND MATERIALS

SUBSISTENCE FISHERY

In 1979 a random sample was taken from the fishermens' nets at the mouth of Salmon River. In 1986 a local Inuit was hired to set his nets as he would if he were fishing for himself. He used 89 mm mesh gill nets set at low tide and pulled at high tide. All fish caught were sampled for later biological analysis.

EXPERIMENTAL GILLNETTING

During the first week of August, 1980, DFO personnel made two sets of experimental gill nets at the mouth of the Salmon River. Standard gangs composed of 47.5 m lengths each of 38, 64, 89, 114 and 139 mm stretched mesh nylon gill nets were used.

In 1986, the Salmon River system was examined by using gill nets of various mesh sizes set at five different locations on the river (Fig. 1).

All fish, from both years, were sampled for later biological analysis.

TAGGING

From 16-23 August 1987, gill nets (64 mm stretched mesh), to capture fish for tagging, were set at the mouth of the Salmon River and in the lake downstream from Utuk Lake (Fig. 1). The fish caught were placed in a measuring trough to obtain a fork length (±1 mm) and to facilitate the insertion of a tag. A floy (spaghetti) tag bearing a reference number and a return address was attached to each fish using a Dennison tagging gun. Tags were inserted in the left side of the fish at the base of the dorsal fin and anchored between the pterygiophores. The Renewable Resource Officer and the local Hunters and Trappers Association informed the community of the reward offered for the return of the fish tags and the tag return information required.

BIOLOGICAL SAMPLING

Fish sampled in 1979 and 1987 were sampled for fork length (±1 mm) only. In 1980 and 1986 charr were sampled for fork length (±1 mm), round weight (±50 g), maturity and aging structure (otolith).

The relative stage of maturity was determined by examination of the gonads and coded according to the stages described in Appendix 1.

Sagittal otoliths were removed and stored dry in coin envelopes. In the laboratory, the otoliths were selectively ground on a carborundum stone and placed in a clearing solution of benzyl benzoate before being read under a binocular dissecting microscope (X30). A reflecting light source against a black background was used to accentuate the annual growth zones which were counted to determine the ages (Grainger 1953).

DATA ANALYSIS

Condition factor (K), a measure of plumpness of the fish, was calculated using the following equation:

$$K = \frac{W \times 10^5}{L^3}$$

where: W = weight in grams
L = length in millimeters

Biological data were analyzed using the Micro Vax II computer. The Staistical Analysis System (1985) was used to generate tables.

RESULTS

MIGRATION/DISTRIBUTION

Two hundred and two Arctic charr from the Salmon River were tagged in 1987; 90 from the mouth of the river and 112 from the unnamed lake just downstream from Utuk Lake. Twenty-five tags were returned from the fall subsistence fishery on Utuk Lake. Seven tags were caught in early July elsewnere on the Salmon River system. The remaining tags were recovered from charr caught in the ocean near Pond Inlet, from a small creek between Salmon River and Pond Inlet and from a creek west of Pond Inlet. The forty-four tags (21%) returned to date indicate that the Arctic charr from Salmon River do not migrate far from their natal river.

AGE AND LENGTH

There was no significant difference ($P>0.05$) between the mean length of Arctic charr sampled from the subsistence fishery in 1979 (X=478 mm) and 1986 (X=491 mm) (Tables 2 and 3). The modal length interval for both years was 450-499 mm which made up 48% (1979) and 45% (1986) of the total catch. There was no significant difference ($P>0.05$) between the length-frequency distributions in the two years.

Ages were not determined for the 1979 sample however the mean age of charr taken in the 1986 subsistence fishery was 10.3 years (mode=10 years) (Table 4).

In 1980, the mean length of charr caught in the experimental gill nets was 405 mm and ranged from 150 mm to 550 mm (Table 5). The modal length was 400-449 mm; this length class composed 35% of the total catch. The mean age was 11.3 and modal age was 12 years (Table 6).

In 1986, mean length and length-frequency distributrions of charr caught from sites 1-3 (Tables 9-11) and site 5 (Table 8) were significantly different ($P<0.05$) from those caught from site 4 (Table 7). Mean age and age-frequency distributions of charr caught from sites 1-3 (Table 13-15) were also significantly different ($P<0.05$) from those caught from site 4 (Table 12). This is likely an indication of the presence of both landlocked and anadromous forms.

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The authors wish to express their appreciation for the assistance provided by other DFO staff. Our thanks to R.W. Moshenko (DFO Winnipeg) for providing the 1979 data and for his technical assistance in the 1986 field survey. Dr. M. Kingsley (DFO Mont-Joli, Quebec) also assisted in the 1986 field survey. Thanks to A.K. Kristofferson (DFO Winnipeg) and G. Low (DFO Hay River, NT) for permission to include their 1980 data in this report. G. Carder (DFO Winnipeg) read the otoliths. D.K. McGowan, B. Dunn and D. Chiperzak provided helpful suggestions and criticisms for both the initial and final drafts.

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We also wish to thank R. Popko and B. Dean for their invaluable support as Renewable Resource Officers, Pond Inlet.

Panoely Okango of Pond Inlet assisted in the sampling of the 1986 subsistence fishery.

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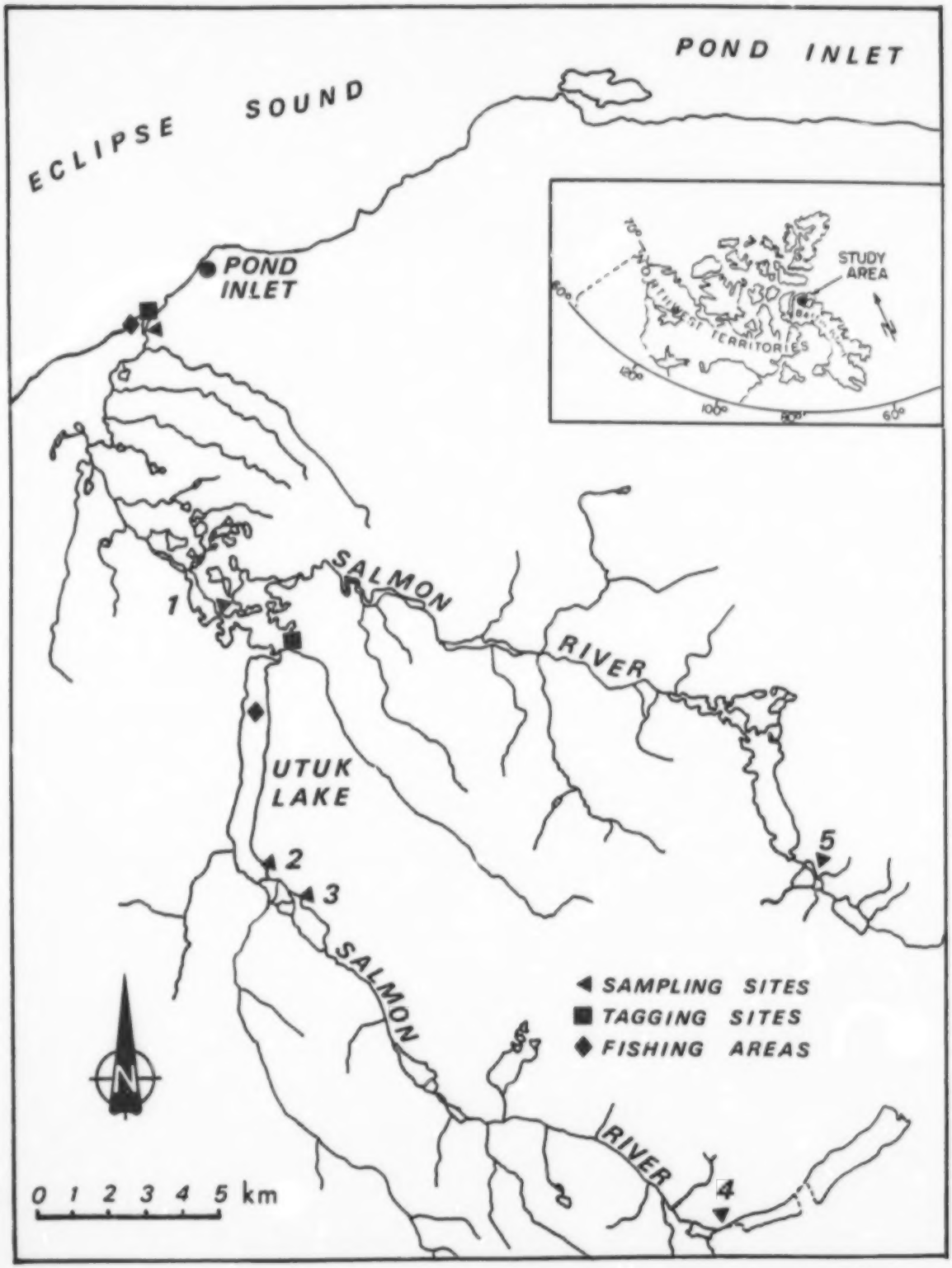

Fig. 1. Map of the Salmon River showing the sampling sites, tagging sites and the fishing areas, 1979-1989.

Table 1. Subsistence harvest of Arctic charr from Salmon River, 1904, 1910 and 1938-89.

Year	Date	Harvest (kg)
1904[1]	Aug.	2 200
1910[2]	Sept.	1 000
1938[3]	17-22 Oct.	800[4]
1939	19-24 Oct.	600[4]
1940	14-26 Oct.	<100[4]
1941	-	-
1942	05-16 Oct.	900
1943	-	-
1944	-	-
1945	26 Sept.-2 Oct.	900
1946	02-15 Oct.	550
1947	13-20 Oct.	450
1948	20-27 Oct.	275
1949	NA	700
1950	NA	200
1951	-	-
1952	NA	325
1953	NA	375
1954	-	-
1955	11-27 Oct.	1 375
1956	05-22 Oct.	2 500
1957	10-26 Oct.	1 550
1958-70		Records from the Renewable Resources Office indicate that there was an abundance of fish prior to 1971.[5]
1971-87		Rapid decline in fishery.[5]
1988		Some increase in fishing but no numbers are available.[5]
1989		2300-3200[5]

[1] Harvest recorded from Low's party (Low 1906) fishing at the mouth of the Salmon River.

[2] Harvest recorded from Bernier's party (Bernier 1912) fishing at the mouth of the Salmon River.

[3] 1938-57 data from RCMP records provided by R. Popko and B. Dean, Department of Renewable Resources, Government of Northwest Territories, Pond Inlet, NT.

[4] Converted from number of fish using 2 kg as average fish weight.

[5] B. Dean, Renewable Resource Officer, Pond Inlet, NT (personal communication).

Table 2. Biological data by length interval for Arctic charr from the subsistence fishery (89 mm mesh), Salmon River, 7 August 1979.

LENGTH INTERVAL (MM)	NO.	PERCENT	MEAN FORK LENGTH(MM)
350	1	3	390
400	4	14	431
450	14	48	466
500	9	31	513
550	1	3	585
TOTAL	29		
MEAN			478

Table 3. Biological data by length interval for Arctic charr from the subsistence fishery (89 mm mesh), Salmon River, 14-15 August 1986.

LENGTH INTERVAL (MM)	MALES						FEMALES						COMBINED					
	N	LENGTH(MM) MEAN	WEIGHT(G) MEAN	WEIGHT(G) SD	K	% MAT	N	LENGTH(MM) MEAN	WEIGHT(G) MEAN	WEIGHT(G) SD	K	% MAT	N	LENGTH(MM) MEAN	WEIGHT(G) MEAN	WEIGHT(G) SD	K	% MAT
400	10	436	980	136	1.18	100	14	439	1164	309	1.38	100	25	438	1084	259	1.29	96
450	29	471	1220	119	1.16	100	44	471	1268	173	1.21	100	74	471	1249	154	1.19	99
500	22	518	1734	280	1.25	100	23	520	1720	300	1.22	100	46	520	1733	287	1.23	98
550	9	567	2306	255	1.26	100	8	574	2269	324	1.20	100	18	569	2278	276	1.23	94
TOTAL	70						89						163					
MEAN		493	1487	462	1.20			488	1458	411	1.24			491	1474	435	1.22	

Table 4. Biological data by age group for Arctic charr from the subsistence fishery (89 mm mesh), Salmon River, 14-15 August 1986.

AGE (YR)	MALES							FEMALES							COMBINED						
	N	LENGTH(MM) MEAN	LENGTH(MM) SD	WEIGHT(G) MEAN	WEIGHT(G) SD	K	% MAT	N	LENGTH(MM) MEAN	LENGTH(MM) SD	WEIGHT(G) MEAN	WEIGHT(G) SD	K	% MAT	N	LENGTH(MM) MEAN	LENGTH(MM) SD	WEIGHT(G) MEAN	WEIGHT(G) SD	K	% MAT
8	4	446	25	1075	222	1.21	100	3	465	31	917	202	0.95	100	8	452	25	1006	197	1.11	100
9	9	475	29	1367	372	1.25	100	6	486	47	1267	432	1.10	100	15	480	36	1327	385	1.19	100
10	34	496	40	1515	462	1.21	100	33	472	27	1338	254	1.27	100	70	486	37	1443	389	1.24	100
11	8	509	57	1656	606	1.21	100	18	503	29	1606	334	1.25	100	26	505	39	1621	423	1.24	100
12	5	512	40	1600	429	1.17	100	5	520	41	1740	334	1.23	100	10	516	39	1670	370	1.20	100
13	1	498	-	1400	-	1.13	100	1	508	-	1250	-	0.95	100	2	503	7	1325	106	1.04	100
14	-	-	-	-	-	-	-	3	503	58	1717	318	1.42	100	3	503	58	1717	318	1.42	100
15	-	-	-	-	-	-	-	1	486	-	1150	-	1.00	100	1	486	-	1150	-	1.00	100
TOTAL	61							70							135						
MEAN		493	42	1488	460	1.21			486	35	1424	346	1.23			490	39	1458	406	1.22	
MEAN AGE	10.1							10.5							10.3						

Table 5. Biological data by length interval for Arctic charr caught in experimental gill nets, Salmon River, 3-5 August 1980.

LENGTH INTERVAL (MM)	MALES						FEMALES						COMBINED					
	LENGTH(MM)		WEIGHT(G)			%	LENGTH(MM)		WEIGHT(G)			%	LENGTH(MM)		WEIGHT(G)			%
	N	MEAN	MEAN	SD	K	MAT	N	MEAN	MEAN	SD	K	MAT	N	MEAN	MEAN	SD	K	MAT
150	6	170	50	0	1.03	0	2	187	50	0	0.77	0	10	172	48	8	0.94	0
200	-	-	-	-	-	-	2	218	100	0	0.99	0	2	218	100	0	0.99	0
300	2	345	400	0	0.97	100	2	328	275	106	0.76	0	9	340	378	87	0.95	22
350	8	381	569	146	1.02	0	8	376	519	88	0.97	0	26	379	558	102	1.03	0
400	17	426	726	117	0.93	12	22	432	807	113	1.00	14	45	428	784	120	1.00	11
450	9	473	1072	170	1.01	11	8	470	856	108	0.83	63	22	470	1025	190	0.99	27
500	4	523	1650	135	1.15	25	5	514	1510	156	1.11	100	11	515	1577	156	1.15	55
550	-	-	-	-	-	-	-	-	-	-	-	-	2	567	1700	212	0.93	0
TOTAL	46						49						127					
MEAN		399	745	429	1.00			414	758	361	0.96			405	765	408	1.01	

Table 6. Biological data by age group for Arctic charr caught in experimental gill nets, Salmon River, 3-5 August 1980.

AGE (YR)	MALES							FEMALES							COMBINED						
	LENGTH(MM)			WEIGHT(G)			%	LENGTH(MM)			WEIGHT(G)			%	LENGTH(MM)			WEIGHT(G)			%
	N	MEAN	SD	MEAN	SD	K	MAT	N	MEAN	SD	MEAN	SD	K	MAT	N	MEAN	SD	MEAN	SD	K	MAT
8	2	365	10	475	35	0.98	0	-	-	-	-	-	-	-	2	365	10	475	35	0.98	0
9	4	394	24	638	189	1.03	0	4	396	31	575	132	0.92	0	8	395	25	606	155	0.97	0
10	6	431	29	808	174	1.00	0	10	420	28	735	118	0.99	20	16	424	28	763	141	0.99	13
11	6	443	37	875	336	0.96	0	8	436	52	888	402	1.01	38	14	439	44	882	361	0.99	21
12	9	472	41	1133	415	1.03	33	9	449	45	889	322	0.96	33	18	461	43	1011	381	1.00	33
13	3	411	25	700	87	1.04	0	3	444	3	833	153	0.95	0	7	423	25	736	146	0.98	0
14	2	474	10	1025	247	0.97	0	1	497	-	1100	-	0.90	100	3	482	15	1050	180	0.95	33
15	1	443	-	750	-	0.86	0	3	458	37	1083	301	1.11	33	4	454	31	1000	297	1.05	25
TOTAL	33							38							72						
MEAN		437	44	870	335	1.00			435	41	832	287	0.98			435	42	845	308	0.99	
MEAN AGE	11.2							11.3							11.3						

Table 7. Biological data by length interval for Arctic charr caught in 38 mm mesh gill net (site 4), Salmon River, 13 August 1986.

LENGTH INTERVAL (MM)	MALES						FEMALES						COMBINED					
		LENGTH(MM)	WEIGHT(G)			%		LENGTH(MM)	WEIGHT(G)			%		LENGTH(MM)	WEIGHT(G)			%
	N	MEAN	MEAN	SD	K	MAT	N	MEAN	MEAN	SD	K	MAT	N	MEAN	MEAN	SD	K	MAT
100	2	131	25	0	1.11	100	1	123	20	-	1.07	100	3	128	23	3	1.10	100
150	2	163	55	7	1.28	100	1	153	40	-	1.12	100	4	159	50	8	1.24	75
TOTAL MEAN	4	147	40	18	1.20		2	138	30	14	1.10		7	146	39	15	1.18	

Table 8. Biological data by length interval for Arctic charr caught in 64 mm mesh gill net (site 5), Salmon River, 13 August 1986.

LENGTH INTERVAL (MM)	MALES						FEMALES						COMBINED					
		LENGTH(MM)	WEIGHT(G)			%		LENGTH(MM)	WEIGHT(G)			%		LENGTH(MM)	WEIGHT(G)			%
	N	MEAN	MEAN	SD	K	MAT	N	MEAN	MEAN	SD	K	MAT	N	MEAN	MEAN	SD	K	MAT
350	1	366	500	-	1.02	0	-	-	-	-	-	-	1	366	500	-	1.02	0
400	1	407	700	-	1.04	100	-	-	-	-	-	-	1	407	700	-	1.04	100
450	-	-	-	-	-	-	2	479	1250	212	1.13	100	2	479	1250	212	1.13	100
500	-	-	-	-	-	-	1	522	1200	-	0.84	100	1	522	1200	-	0.84	100
TOTAL MEAN	2	387	600	141	1.03		3	493	1233	153	1.04		5	451	980	370	1.03	

Table 9. Biological data by length interval for Arctic charr caught in 89 mm mesh gill net (site 1), Salmon River, 13 August 1986.

LENGTH INTERVAL (MM)	MALES						FEMALES						COMBINED					
	LENGTH(MM)		WEIGHT(G)			%	LENGTH(MM)		WEIGHT(G)			%	LENGTH(MM)		WEIGHT(G)			%
	N	MEAN	MEAN	SD	K	MAT	N	MEAN	MEAN	SD	K	MAT	N	MEAN	MEAN	SD	K	MAT
350	1	396	800	-	1.29	100	-	-	-	-	-	-	1	396	800	-	1.29	100
400	17	426	959	209	1.23	71	4	427	1025	150	1.32	100	22	426	964	197	1.24	73
450	9	477	1267	148	1.16	100	4	469	1275	96	1.24	100	13	474	1269	130	1.19	100
500	4	531	1875	340	1.25	100	5	511	1620	239	1.21	80	10	520	1730	283	1.22	80
550	2	550	1700	141	1.02	100	-	-	-	-	-	-	3	550	1850	278	1.11	67
600	2	605	2500	283	1.13	100	1	624	3000	-	1.23	100	3	611	2667	351	1.16	100
TOTAL	35						14						52					
MEAN		468	1269	487	1.20			483	1450	535	1.25			473	1334	509	1.21	

Table 10. Biological data by length interval for Arctic charr caught in 114 mm mesh gill net (site 3), Salmon River, 13 August 1986

LENGTH INTERVAL (MM)	MALES						FEMALES						COMBINED					
	LENGTH(MM)		WEIGHT(G)			%	LENGTH(MM)		WEIGHT(G)			%	LENGTH(MM)		WEIGHT(G)			%
	N	MEAN	MEAN	SD	K	MAT	N	MEAN	MEAN	SD	K	MAT	N	MEAN	MEAN	SD	K	MAT
450	-	-	-	-	-	-	1	466	900	-	0.89	100	1	466	900	-	0.89	100
500	-	-	-	-	-	-	1	500	1550	-	1.24	0	1	500	1550	-	1.24	0
550	-	-	-	-	-	-	3	572	2283	189	1.22	67	3	572	2283	189	1.22	67
600	2	614	2725	247	1.18	100	-	-	-	-	-	-	2	614	2725	247	1.18	100
650	1	678	4000	-	1.28	100	-	-	-	-	-	-	1	678	4000	-	1.28	100
750	1	750	4500	-	1.07	100	-	-	-	-	-	-	1	750	4500	-	1.07	100
TOTAL	4						5						9					
MEAN		664	3488	915	1.18			536	1860	638	1.16			593	2583	1119	1.17	

Table 11. Biological data by length interval for Arctic charr caught in 139 mm mesh gill net (site 2), Salmon River, 13 August 1986

LENGTH INTERVAL (MM)	MALES						FEMALES						COMBINED					
	N	LENGTH(MM) MEAN	WEIGHT(G) MEAN	WEIGHT(G) SD	K	% MAT	N	LENGTH(MM) MEAN	WEIGHT(G) MEAN	WEIGHT(G) SD	K	% MAT	N	LENGTH(MM) MEAN	WEIGHT(G) MEAN	WEIGHT(G) SD	K	% MAT
550	-	-	-	-	-	-	3	563	2117	425	1.18	100	4	563	1863	616	1.04	75
600	2	618	2425	601	1.04	100	-	-	-	-	-	-	2	618	2425	601	1.04	100
TOTAL	2						3						6					
MEAN		618	2425	601	1.04			563	2117	425	1.18			581	2050	620	1.04	

Table 12. Biological data by age group for Arctic charr caught in 38 mm mesh gill net (site 4), Salmon River, 13 August 1986.

AGE (YR)	MALES							FEMALES							COMBINED					
	N	LENGTH(MM) MEAN	LENGTH(MM) SD	WEIGHT(G) MEAN	WEIGHT(G) SD	K	% MAT	N	LENGTH(MM) MEAN	LENGTH(MM) SD	WEIGHT(G) MEAN	WEIGHT(G) SD	K	% MAT	N	LENGTH(MM) MEAN	LENGTH(MM) SD	WEIGHT(G) MEAN	WEIGHT(G) SD	K	% MAT
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	158	-	50	-	1.27	-
9	1	169	-	60	-	1.24	100	-	-	-	-	-	-	-	1	169	-	60	-	1.24	100
11	1	129	-	25	-	1.16	100	-	-	-	-	-	-	-	1	129	-	25	-	1.16	100
15	1	133	-	25	-	1.06	100	1	153	-	40	-	1.12	100	2	143	14	33	11	1.09	100
16	1	156	-	50	-	1.32	100	-	-	-	-	-	-	-	1	156	-	50	-	1.32	100
TOTAL	4							1							6						
MEAN		147	19	40	18	1.20			153	-	40	-	1.12			150	15	42	14	1.20	
MEAN AGE	12.8							15.0							12.3						

Table 13. Biological data by age group for Arctic charr caught in 89 mm mesh gill net (site 1), Salmon River, 13 August 1986.

AGE (YR)	MALES N	LENGTH(MM) MEAN	SD	WEIGHT(G) MEAN	SD	K	% MAT	FEMALES N	LENGTH(MM) MEAN	SD	WEIGHT(G) MEAN	SD	K	% MAT	COMBINED N	LENGTH(MM) MEAN	SD	WEIGHT(G) MEAN	SD	K	% MAT
8	1	491	-	1400	-	1.18	100	-	-	-	-	-	-	-	1	491	-	1400	-	1.18	100
9	4	421	15	875	150	1.16	75	1	400	-	800	-	1.25	100	5	417	16	860	134	1.18	80
10	16	462	40	1256	382	1.25	81	6	477	24	1350	259	1.24	83	23	469	38	1300	352	1.25	78
11	5	485	68	1270	463	1.08	80	3	454	46	1267	289	1.35	100	8	474	59	1269	383	1.18	88
12	3	503	88	1533	709	1.16	100	1	500	-	1300	-	1.04	100	5	484	74	1340	594	1.13	80
13	-	-	-	-	-	-	-	3	545	76	2100	819	1.26	100	3	545	76	2100	819	1.26	100
14	1	533	-	2000	-	1.32	100	-	-	-	-	-	-	-	1	533	-	2000	-	1.32	100
TOTAL	30							14							46						
MEAN		468	52	1265	436	1.20			483	55	1450	535	1.25			472	53	1321	471	1.22	
MEAN AGE		10.3							10.9							10.5					

Table 14. Biological data by age group for Arctic charr caught in 114 mm mesh gill net (site 3), Salmon River, 13 August 1986.

AGE (YR)	MALES N	LENGTH(MM) MEAN	SD	WEIGHT(G) MEAN	SD	K	% MAT	FEMALES N	LENGTH(MM) MEAN	SD	WEIGHT(G) MEAN	SD	K	% MAT	COMBINED N	LENGTH(MM) MEAN	SD	WEIGHT(G) MEAN	SD	K	% MAT
10	-	-	-	-	-	-	-	1	466	-	900	-	0.89	100	1	466	-	900	-	0.89	100
11	1	602	-	2550	-	1.17	100	1	556	-	2150	-	1.25	0	2	579	33	2350	283	1.21	50
12	1	625	-	2900	-	1.19	100	1	580	-	2200	-	1.13	100	2	603	32	2550	495	1.16	100
13	1	678	-	4000	-	1.20	100	-	-	-	-	-	-	-	1	678	-	4000	-	1.28	100
14	1	750	-	4500	-	1.07	100	1	580	-	2500	-	1.28	100	2	665	120	3500	1414	1.17	100
TOTAL	4							4							8						
MEAN		664	66	3488	915	1.18			546	54	1938	709	1.14			605	84	2713	1123	1.16	
MEAN AGE		12.5							11.8							12.1					

Table 15. Biological data by age group for Arctic charr caught in 139 mm mesh gill net (site 2), Salmon River, 13 August 1986.

AGE (YR)	MALES							FEMALES							COMBINED						
	LENGTH(MM)			WEIGHT(G)		K	% MAT	LENGTH(MM)			WEIGHT(G)		K	% MAT	LENGTH(MM)			WEIGHT(G)		K	% MAT
	N	MEAN	SD	MEAN	SD			N	MEAN	SD	MEAN	SD			N	MEAN	SD	MEAN	SD		
10	1	610	-	2850	-	1.26	100	-	-	-	-	-	-	-	1	610	-	2850	-	1.26	100
11	-	-	-	-	-	-	-	1	550	-	1700	-	1.02	100	1	550	-	1700	-	1.02	100
12	-	-	-	-	-	-	-	1	558	-	2100	-	1.21	100	1	558	-	2100	-	1.21	100
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	563	-	1100	-	0.62	-
TOTAL	1							2							4						
MEAN		610	-	2850	-	1.26			554	6	1900	283	1.12			570	27	1938	734	1.03	
MEAN AGE	10.0							11.5							11.5						

Appendix 1. A description of the relative stages of maturity used for northern fishes.

MATURITY FLOW CHART

FISH MATURITY CODE

Maturity Stage		Female		Male
Immature (virgin)	1	-Ovaries granular in texture -hard and triangular in shape -up to full length of body cavity -membrane firm -eggs distinguishable	6	-Testes long and granular -tubular and scalloped shape -up to full body length -putty like firmness
Mature	2	-Current year spawner -ovary fills body cavity -eggs near full size but not loose -not expelled by pressure	7	-Current year spawner -testes large and lobate -white to purplish color -centers may be fluid -milt not expelled by pressure
Ripe	3	-Ovaries greatly extended & fill body cavity -eggs full size and transparent -eggs expelled by slight pressure	8	-Testes full size -white and lobate -milt expelled by slight pressure
Spent	4	-Spawning complete -ovaries ruptured and flaccid -seed eggs visible -some retained eggs in body cavity	9	-Spawning complete -testes flaccid with some milt -blood vessels obvious -testes violet-pink in color
Resting	5	-Ovary 40-50% of body cavity -membrane thin, loose, & semi-transparent -healed from spawning -seed eggs apparent with few atretic eggs -some eggs may be retained in body cavity	10	-Testes tubular, less lobate -healed from spawning -no fluid in center -usually full length -mottled and purplish in color
Unknown (virgin)	0	-cannot be sexed -gonads long or short & thin -transparent or translucent		
Unknown (non-virgin)	11	-resting fish -has spawned but gonads regenerated -sexing not possible		

Appendix 2. Biological data by length interval for Arctic charr caught in 38 mm mesh gill nets, Salmon River, 3-5 August 1980.

LENGTH INTERVAL (MM)	MALES						FEMALES						COMBINED					
	N	LENGTH(MM) MEAN	WEIGHT(G) MEAN	SD	K	% MAT	N	LENGTH(MM) MEAN	WEIGHT(G) MEAN	SD	K	% MAT	N	LENGTH(MM) MEAN	WEIGHT(G) MEAN	SD	K	% MAT
150	6	170	50	0	1.03	0	2	187	50	0	0.77	0	10	172	48	8	0.94	0
200	-	-	-	-	-	-	2	218	100	0	0.99	0	2	218	100	0	0.99	0
300	-	-	-	-	-	-	-	-	-	-	-	-	1	342	300	-	0.75	0
350	1	397	500	-	0.80	0	-	-	-	-	-	-	1	397	500	-	0.80	0
400	1	436	750	-	0.90	0	10	437	845	98	1.02	10	11	437	836	98	1.01	9
450	-	-	-	-	-	-	2	486	975	177	0.85	100	2	486	975	177	0.85	100
500	1	510	1700	-	1.28	0	2	516	1650	0	1.21	100	3	514	1667	29	1.23	67
TOTAL MEAN	9	263	361	564	1.02		18	399	778	469	0.99		30	340	588	528	0.98	

Appendix 3. Biological data by length interval for Arctic charr caught in 64 mm mesh gill nets, Salmon River, 3-5 August 1980.

LENGTH INTERVAL (MM)	MALES						FEMALES						COMBINED					
	N	LENGTH(MM) MEAN	WEIGHT(G) MEAN	SD	K	% MAT	N	LENGTH(MM) MEAN	WEIGHT(G) MEAN	SD	K	% MAT	N	LENGTH(MM) MEAN	WEIGHT(G) MEAN	SD	K	% MAT
300	1	342	400	-	1.00	100	2	328	275	106	0.76	0	4	336	338	95	0.87	25
350	4	372	475	29	0.92	0	4	382	575	29	1.03	0	12	381	546	62	0.99	0
400	4	424	650	122	0.85	25	5	428	790	164	1.00	20	11	427	755	152	0.96	18
450	1	452	950	-	1.03	0	3	476	817	29	0.76	100	6	469	958	183	0.94	50
500	1	532	1750	-	1.16	100	1	500	1400	-	1.12	100	2	516	1575	247	1.14	100
TOTAL MEAN	11	410	691	389	0.93		15	417	710	282	0.94		35	413	717	311	0.97	

Appendix 4. Biological data by length interval for Arctic charr caught in 89 mm mesh gill nets, Salmon River, 3-5 August 1980.

LENGTH INTERVAL (MM)	MALES						FEMALES						COMBINED					
	LENGTH(MM)		WEIGHT(G)			%	LENGTH(MM)		WEIGHT(G)			%	LENGTH(MM)		WEIGHT(G)			%
	N	MEAN	MEAN	SD	K	MAT	N	MEAN	MEAN	SD	K	MAT	N	MEAN	MEAN	SD	K	MAT
300	1	348	400	-	0.95	100	-	-	-	-	-	-	3	342	450	50	1.13	33
350	3	389	717	144	1.23	0	3	364	417	29	0.87	0	11	373	568	144	1.08	0
400	6	426	775	104	1.00	0	4	434	738	75	0.90	0	14	426	789	102	1.03	0
450	3	467	1033	144	1.01	33	2	454	775	35	0.83	0	7	462	1014	208	1.02	14
550	-	-	-	-	-	-	-	-	-	-	-	-	2	567	1700	212	0.93	0
TOTAL	13						9						37					
MEAN		421	792	201	1.05			415	639	175	0.87			418	788	314	1.05	

Appendix 5. Biological data by length interval for Arctic charr caught in 114 mm mesh gill nets, Salmon River, 3-5 August 1980.

LENGTH INTERVAL (MM)	MALES						FEMALES						COMBINED					
	LENGTH(MM)		WEIGHT(G)			%	LENGTH(MM)		WEIGHT(G)			%	LENGTH(MM)		WEIGHT(G)			%
	N	MEAN	MEAN	SD	K	MAT	N	MEAN	MEAN	SD	K	MAT	N	MEAN	MEAN	SD	K	MAT
400	3	431	767	161	0.95	0	1	416	800	-	1.10	0	4	428	775	132	0.99	0
450	4	481	1188	149	1.07	0	1	453	900	-	0.97	0	6	474	1150	170	1.08	0
500	1	518	1450	-	1.04	0	2	519	1425	177	1.02	100	5	513	1500	166	1.12	40
TOTAL	8						4						15					
MEAN		467	1063	291	1.02			477	1138	350	1.02			474	1167	325	1.07	

Appendix 6. Biological data by length interval for Arctic charr caught in 139 mm mesh gill nets, Salmon River, 3-5 August 1980.

LENGTH INTERVAL (MM)	MALES						FEMALES						COMBINED					
	N	LENGTH(MM) MEAN	WEIGHT(G) MEAN	WEIGHT(G) SD	K	% MAT	N	LENGTH(MM) MEAN	WEIGHT(G) MEAN	WEIGHT(G) SD	K	% MAT	N	LENGTH(MM) MEAN	WEIGHT(G) MEAN	WEIGHT(G) SD	K	% MAT
300	-	-	-	-	-	-	-	-	-	-	-	-	1	347	400	-	0.96	0
350	-	-	-	-	-	-	1	390	600	-	1.01	0	2	388	600	0	1.03	0
400	3	423	683	104	0.90	33	2	421	800	141	1.07	50	5	422	730	120	0.97	40
450	1	481	850	-	0.76	0	-	-	-	-	-	-	1	481	850	-	0.76	0
500	1	532	1700	-	1.13	0	-	-	-	-	-	-	1	532	1700	-	1.13	0
TOTAL	5						3						10					
MEAN		456	920	448	0.92			411	733	153	1.05			425	780	354	0.98	

Appendix 7. Biological data by age group for Arctic charr caught in 38 mm mesh gill nets, Salmon River, 3-5 August 1980.

AGE (YR)	MALES							FEMALES							COMBINED					
	N	LENGTH(MM) MEAN	LENGTH(MM) SD	WEIGHT(G) MEAN	WEIGHT(G) SD	K	% MAT	N	LENGTH(MM) MEAN	LENGTH(MM) SD	WEIGHT(G) MEAN	WEIGHT(G) SD	K	% MAT	N	LENGTH(MM) MEAN	LENGTH(MM) SD	WEIGHT(G) MEAN	WEIGHT(G) SD	K	% MAT
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	162	14	38	18	0.85	0
6	1	161	-	50	-	1.20	0	-	-	-	-	-	-	-	1	161	-	50	-	1.2[illegible]	0
7	2	177	11	50	0	0.92	0	1	193	-	50	-	0.70	0	3	182	12	50	0	0.8[illegible]	0
8	1	165	-	50	-	1.11	0	1	204	-	100	-	1.18	0	2	185	28	75	35	1.15	0
10	2	307	183	475	601	0.99	0	3	342	139	700	568	1.19	0	5	328	136	610	516	1.11	0
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	506	-	1650	-	1.27	100
12	1	510	-	1700	-	1.28	0	5	437	10	970	76	1.16	0	8	462	38	1150	330	1.15	25
13	-	-	-	-	-	-	-	2	445	1	1025	35	1.16	0	2	445	1	1025	35	1.16	0
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	497	-	1400	-	1.14	100
TOTAL	7							12							25						
MEAN		257	149	407	652	1.06			375	110	763	424	1.13			345	144	711	593	1.09	
MEAN AGE		8.6							10.9							10.0					

Appendix 8. Biological data by age group for Arctic charr caught in 64 mm mesh gill nets, Salmon River, 3-5 August 1980.

AGE (YR)	MALES N	MALES LENGTH(MM) MEAN	MALES LENGTH(MM) SD	MALES WEIGHT(G) MEAN	MALES WEIGHT(G) SD	MALES K	MALES % MAT	FEMALES N	FEMALES LENGTH(MM) MEAN	FEMALES LENGTH(MM) SD	FEMALES WEIGHT(G) MEAN	FEMALES WEIGHT(G) SD	FEMALES K	FEMALES % MAT	COMBINED N	COMBINED LENGTH(MM) MEAN	COMBINED LENGTH(MM) SD	COMBINED WEIGHT(G) MEAN	COMBINED WEIGHT(G) SD	COMBINED K	COMBINED % MAT
8	2	365	10	475	35	0.98	0	-	-	-	-	-	-	-	2	365	10	475	35	0.98	0
9	2	379	16	525	106	0.96	0	2	396	37	700	212	1.11	0	4	388	25	613	170	1.03	0
10	-	-	-	-	-	-	-	3	359	45	550	265	1.11	0	5	397	61	720	299	1.09	40
11	3	391	45	650	260	1.07	33	2	402	18	725	177	1.11	0	5	395	33	680	208	1.09	20
12	3	468	58	1233	671	1.12	67	-	-	-	-	-	-	-	4	474	49	1238	548	1.10	75
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	395	-	650	-	1.05	-
15	1	443	-	850	-	0.98	0	1	443	-	1050	-	1.21	0	3	462	33	1100	278	1.10	33
TOTAL	11							8							24						
MEAN		410	54	773	451	1.04			389	41	694	241	1.12			413	52	804	372	1.07	
MEAN AGE		10.7							10.6							11.0					

Appendix 9. Biological data by age group for Arctic charr caught in 89 mm mesh gill nets, Salmon River, 3-5 August 1980.

AGE (YR)	MALES N	MALES LENGTH(MM) MEAN	MALES LENGTH(MM) SD	MALES WEIGHT(G) MEAN	MALES WEIGHT(G) SD	MALES K	MALES % MAT	FEMALES N	FEMALES LENGTH(MM) MEAN	FEMALES LENGTH(MM) SD	FEMALES WEIGHT(G) MEAN	FEMALES WEIGHT(G) SD	FEMALES K	FEMALES % MAT	COMBINED N	COMBINED LENGTH(MM) MEAN	COMBINED LENGTH(MM) SD	COMBINED WEIGHT(G) MEAN	COMBINED WEIGHT(G) SD	COMBINED K	COMBINED % MAT
8	1	348	-	500	-	1.19	100	-	-	-	-	-	-	-	1	348	-	500	-	1.19	100
9	1	392	-	550	-	0.91	0	2	395	38	625	247	0.98	0	3	394	27	600	180	0.96	0
10	3	410	22	850	180	1.22	0	1	452	-	1150	-	1.25	0	4	421	27	925	210	1.23	0
11	2	427	21	875	106	1.12	0	3	418	54	800	265	1.07	0	5	422	40	830	199	1.09	0
12	2	460	16	1125	35	1.16	50	1	367	-	500	-	1.01	0	3	429	55	917	362	1.11	33
13	1	382	-	600	-	1.08	0	1	441	-	850	-	0.99	0	2	412	42	725	177	1.03	0
14	1	467	-	1300	-	1.28	0	-	-	-	-	-	-	-	1	467	-	1300	-	1.28	0
15	-	-	-	-	-	-	-	1	430	-	1100	-	1.38	0	1	430	-	1100	-	1.38	0
TOTAL	11							9							20						
MEAN		418	38	864	266	1.15			415	40	806	266	1.09			416	38	838	261	1.12	
MEAN AGE		10.9							11.2							11.1					

Appendix 10. Biological data by age group for Arctic charr caught in 114 mm mesh gill nets, Salmon River, 3-5 August 1980.

AGE (YR)	MALES N	MALES LENGTH(MM) MEAN	MALES LENGTH(MM) SD	MALES WEIGHT(G) MEAN	MALES WEIGHT(G) SD	MALES K	MALES % MAT	FEMALES N	FEMALES LENGTH(MM) MEAN	FEMALES LENGTH(MM) SD	FEMALES WEIGHT(G) MEAN	FEMALES WEIGHT(G) SD	FEMALES K	FEMALES % MAT	COMBINED N	COMBINED LENGTH(MM) MEAN	COMBINED LENGTH(MM) SD	COMBINED WEIGHT(G) MEAN	COMBINED WEIGHT(G) SD	COMBINED K	COMBINED % MAT
10	2	460	18	1100	212	1.12	0	1	418	-	900	-	1.23	0	3	446	28	1033	189	1.16	0
11	2	487	16	1375	35	1.19	0	-	-	-	-	-	-	-	3	491	13	1450	132	1.22	33
12	3	471	49	1283	535	1.17	0	-	-	-	-	-	-	-	3	471	49	1283	535	1.17	0
13	1	425	-	800	-	1.04	0	-	-	-	-	-	-	-	1	425	-	800	-	1.04	0
TOTAL	8							1							10						
MEAN		467	34	1200	355	1.15			418	-	900	-	1.23			465	36	1210	354	1.17	
MEAN AGE		11.4							10.0							11.2					

Appendix 11. Biological data by age group for Arctic charr caught in 139 mm mesh gill nets, Salmon River, 3-5 August 1980.

AGE (YR)	MALES N	MALES LENGTH(MM) MEAN	MALES LENGTH(MM) SD	MALES WEIGHT(G) MEAN	MALES WEIGHT(G) SD	MALES K	MALES % MAT	FEMALES N	FEMALES LENGTH(MM) MEAN	FEMALES LENGTH(MM) SD	FEMALES WEIGHT(G) MEAN	FEMALES WEIGHT(G) SD	FEMALES K	FEMALES % MAT	COMBINED N	COMBINED LENGTH(MM) MEAN	COMBINED LENGTH(MM) SD	COMBINED WEIGHT(G) MEAN	COMBINED WEIGHT(G) SD	COMBINED K	COMBINED % MAT
9	1	426	-	800	-	1.03	0	-	-	-	-	-	-	-	1	426	-	800	-	1.03	0
10	-	-	-	-	-	-	-	2	403	18	725	177	1.10	0	2	403	18	725	177	1.10	0
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	426	-	900	-	1.16	100
13	1	425	-	800	-	1.04	0	-	-	-	-	-	-	-	1	425	-	800	-	1.04	0
14	1	481	-	1050	-	0.94	0	-	-	-	-	-	-	-	1	481	-	1050	-	0.94	0
TOTAL	3							2							6						
MEAN		444	32	883	144	1.01			403	18	725	177	1.10			427	30	833	147	1.06	
MEAN AGE		12.0							10.0							11.2					